PHSA 8B

Full Marks-50
Attempt one question from Group A and one question from Group B

Programming Language: C or Fortran

Group-A
Each question carries 20 marks

A1. Write a program to find the sum of first ten prime numbers after 100. Display these numbers and their sum.

A2. Read 15 real numbers, some of which are negative. Put the positive numbers in an array. Display the newly created list and sum of squares of the elements of it. Run the program with the array

9.8, -5.6, 3.22, 1.42, -4.8, -7.2, 0.56, -6.5, 8.54, -0.1

A3. Read the following numbers and sort them in ascending order

9.8, -5.6, 2.33, 1.24, -4.8, -7.2, 0.56, -6.5, 8.45, -0.1

(Flow chart/Algorithm -2, Program-8, Result-2)

A4. Calculate the partial sum of following series

$$s = \frac{1\cdot 2}{3\cdot 4} + \frac{2\cdot 3}{4\cdot 5} + \frac{3\cdot 4}{5\cdot 6} + \cdots$$

for 9 terms, 11 terms and 15 terms.

A5. Calculate the following expression

$$\prod_{p=prime} \frac{1}{1-p^{-s}}$$

upto first 7 prime numbers (p) for $s = 2$.

A6. Find the factors of the number 3604 and calculate the sum of the factors.

A7. Find the prime factors only for the number 10395.

A8. Calculate $\log(100!)$ by using the relation

$$\log(n!) = \sum_{i=2}^{n} \log(i)$$

Also, print the value obtained from Stirling's approximation, $\log(n!) = n \log n - n$.

A9. Given two matrices, $A = \begin{pmatrix} 1 & 2 & 3 \\ 3 & 2 & 4 \\ 4 & 6 & 5 \end{pmatrix}$ and $B = \begin{pmatrix} 3 & 2 & 1 \\ 5 & 4 & 3 \\ 6 & 5 & 3 \end{pmatrix}$. Write a program to verify $(AB)^T = B^T A^T$.

A10. Show that the matrix $A = \begin{pmatrix} 1 & -2 \\ 4 & 5 \end{pmatrix}$ satisfies the characteristics equation $A^2 - 6A + 13I = 0$, where I is an identity matrix of order 2.

Group B
Each question carries 30 marks

B1. Use *Gauss Seidel* method (without rearrangement or reifnement) to solve the simultaneous equations

$$\begin{aligned} 6x + 2y + z &= 13 \\ 3x + 7y - 2z &= 11 \\ x - 3y - 8z &= -29 \end{aligned}$$

B2. Calculate the position of the particle (x) at $t = 2.75$ sec from the following data using Lagrange's Interpolation method.

t sec	1	1.5	2	2.5	3	3.5	4
x m	10.7	22.8	39.6	61.25	87.9	119.7	156.8

B3. Using the following data, calculate the values of m for *least square fit* to a stright line of the form $y = mx$.

x	-3.2	-1.5	2	2.74	3.1	4.22	5.9	8.7
y	-10.38	-4.29	6.49	8.89	10.06	13.70	18.65	28.24

B4.Using the following data, calculate the values of m and c for *least square fit* to a stright line of the form $y = mx + c$.

x	-5.2	-4.3	-3.2	-1.7	1.4	2.7	3.3	4.4
y	16.22	14.24	11.82	8.52	1.70	-1.16	-2.48	-4.90

B5. Using the *bisection method*, find the root of the equation

$$e^{-x} + 10\sin(x) = -2$$

that lies in the range $2 < x < 4$, correct upto third place of decimal.

B6. Using the *Newton Raphson method*, find the root of the equation

$$\sin(x) - x + 3 = 0$$

that lies in the range $2 < x < 4.5$, correct upto third place of decimal.

B7. Using *trapezoidal rule*, calculate

$$\int_{\pi/3}^{\pi/2} x^{3/2} e^{-x}\, dx$$

correct upto 3 decimal places.

B8. Using *trapezoidal rule*, calculate

$$\int_{1}^{3} \left(x^2 + x\right) \sin x\, dx$$

correct upto 3 decimal places.

B9. Using *Simpson's 1/3rd rule*, calculate

$$\int_{0}^{1} x^3 \sqrt{2 - x^2} dx$$

correct upto 3 decimal places.

B10. Using *Simpson's 1/3rd rule*, calculate

$$\int_{1}^{2} \frac{2y^3 - 6}{y^2} dy$$

correct upto 3 decimal places.